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H. M. Savage

CANADIAN PACIFIC RAILWAY COMPANY'S IRRIGATION SYSTEM IN ALBERTA

INTERNATIONAL IRRIGATION CONGRESS

Calgary

1914

COMPLIMENTS
OF THE
CANADIAN PACIFIC RAILWAY.

Canadian Pacific Railway

Company's

Irrigation Systems in Alberta

SOUVENIR

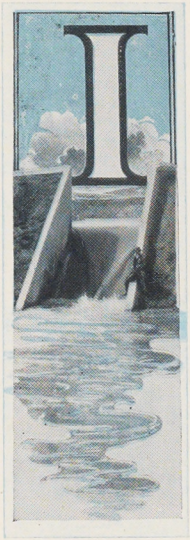
of the

INTERNATIONAL IRRIGATION

C O N G R E S S

CALGARY, OCTOBER 1914

CANADIAN PACIFIC RAILWAY COMPANY'S IRRIGATION SYSTEMS IN ALBERTA



IRRIGATION is at once the most youthful and the oldest method of agriculture in the world. Buried in the waste and sands of centuries have been found irrigation dams, conduits and canals that outclass many of the latest and greatest feats of engineering skill and inspire the deepest admiration and respect for the unknown engineers of antiquity. Sir William Wilcocks, one of the most distinguished living irrigation engineers, a student of irrigation systems in all parts of the world, and the designer of the most notable irrigation structure of modern times, the Assuan Dam, has made the statement that the application of water by artificial means to benefit agricultural operations can be traced as far back as the Garden of Eden. It is at any rate certain that where—according to some historians—civilization first arose, in the valley of the Euphrates and Tigris rivers in Asia Minor, was once a densely populated region in a state of very high cultivation; and where and when Nebuchadnezzar set up his golden image were fertile plains traversed in every direction by a network of canals and ditches. Chaldea's rich irrigated lands were indeed the secret of her wealth, and the reason why she was so often the prey of envious neighboring nations.

It was irrigation, say some archeologists, that made the Land of Goshen such a fruitful land in Joseph's time, so that when there was drought and famine elsewhere all peoples came to Egypt to buy corn. More than forty centuries ago, an Egyptian king, Amenemhat III, built the most famous reservoir of either ancient or modern times, Lake Moeris, constructed for the purpose of receiving and distributing the

waters of the Nile. This reservoir was nearly 2,500 acres in extent. One of the largest irrigation dams of any time was that built in the home of the ancient Sabaeans, about 1,760 B.C., its length being 10,560 feet, its height 120 feet and its thickness 500 feet.

Great irrigationists were the Romans. No other structures in the Eternal City matched, as regards either magnitude or value, the wonderful aqueducts and conduits that, carrying water for distances varying from fifty to two hundred miles, provided Rome with a domestic supply that has been estimated at over three hundred millions gallons daily. Irrigation farming was understood and practised by the Latin farmer. The poet Virgil describes, in one of his poems, the Roman husbandman as decoying the torrent when the fields were scorched with raging heat, and allaying the thirsty lands with gurgling streams. When the Romans conquered the greater part of then known Europe, colonizing and civilizing barbaric countries, they constructed irrigation works as well as roads, taking artificers and engineers from the famous systems in North Africa to establish in Italy, Gaul and even in the Isles of Britain works of a similar kind. In Southern France, Julius Cæsar built aqueducts rivalling those of ancient Carthage, and he built so well that some of them are still in use to-day, more than two thousand years old. In mediæval times the conquering Saracens of Asia Minor and North Africa, and the Moors of Southern Spain, extended and improved existing irrigation practices, and became the most successful irrigators of the world. Living in an age of strife and struggle, they redeemed dreary wastes and converted them into fertile, fruitful fields.

Literature, it has been said, has always flourished most in periods of commercial expansion. Equally, the study of these early systems of irrigation demonstrates that the engineering works of greatest magnitude were built during the periods of the greatest progress in literature and the industrial arts. Civilization, with all the culture that it implies, and irrigation went hand in hand; only during the Dark Ages did both art and irrigation languish.

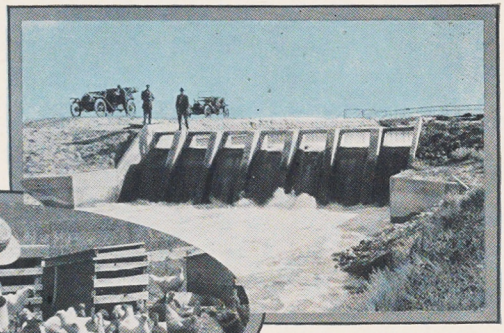
PREHISTORIC IRRIGATION IN AMERICA

The history of irrigation on the American continent dates back to prehistoric times. The Pueblo builders of the south-west United States have left evidences, in New Mexico, Arizona and south-western Colorado, of extensive systems with, sometimes, individual canals twenty miles or more in length—canals so well constructed that their beds have been utilized by modern ditch builders. When the Spanish Conqueror Cortez came to Mexico, he found there a well-governed and exceedingly productive empire. Probably nowhere in the sixteenth century could have been found a better system of irrigation than that inaugurated by the Montezumas; the greatest cities of Central America, the ruins of which, centuries old, excite wonder and admiration for the architectural skill of the builders, suggest that there must have been a highly developed system of farming under irrigation to sustain the population of these cities and give stability and support to their pastoral race. "Nothing of modern day methods," says Professor W. H. Olin, "seems to compare with the agriculture these Aztec people are believed to have practised centuries ago, from south-west Colorado on the north, through Old Mexico as we know it to-day, down to the narrow Isthmus of Panama on the south."

The records of this strange, yet undoubtedly progressive people, were, alas, blotted out by the vindictive invaders; equally unfortunate was the loss of those of the Incas, the conquest of whom by Pizarro has been characterized as the most ruthless, cruel and inexcusable of either ancient or modern times. They, too, had carefully worked out and well distributed irrigation systems. The canals, the subterraneous aqueducts which converted the rarely-watered though rich soil into a rich and variegated carpet of verdure, the terraces raised up the steep sides of the Cordillera and exhibiting in regular gradation every variety of vegetable form, are to be found described in the vivid pages of the historian Prescott.

MODERN IRRIGATION

It is almost a task of supererogation to discuss the development of irrigation in the United States, because it has taken place so recently that it is within the lifetime of men not yet arrived at middle age. Twenty years ago the cost of the then existing irrigation enterprises in the United States was less than thirty million dollars, an insignificant sum when compared with the magnitude of the results achieved—to-day, the cost of existing systems lies between four and five hundred million. In the last census year (1910), there were in the so-called "arid region" of the United States—the tier of states formed by the Dakotas, Nebraska, Kansas, Oklahoma and Texas, and all of the states lying between these and the Pacific Coast—no less than 54,700 irrigation enterprises of all kinds, including those established under the various laws, co-operative enterprises and commercial enterprises.



Concrete Drop, Secondary Canal "C," Western Section.

The Farmer's Wife Finds Pin-money.

These enterprises, by means of 81,837 main and lateral canals, with a total mileage of 125,591 miles, and 6,812 reservoirs with a capacity of 12,581,129 acre feet, were on July 1st, 1910, capable of irrigating 19,334,697 acres and actually irrigated 13,738,485 acres —the latter being 1.2% of the total land area of the states in question, 3.5% of the total area of the farms in those states, and 7.9% of the

area of improved lands in farms. The total acreage of all projects, whether completed when the census was taken or in process of development, was 31,111,142 acres, and the number of farms irrigated was 158,713—11% of the total number in the states included. It is notable that while the total number of farms in the region had increased 31.5% in the ten years since the previous census, the number of irrigated farms had increased 47.7%. The cost of the construction of these enterprises, on July 1st, totalled $307,866,369—the total cost to the end of 1910 was estimated at $424,281,186, representing an expenditure during the decennial period of over $350,000,000, and the average cost per acre, based on the latter estimate, and on the acreage included in the projects, was $13.64, ranging actually from an average of $5.53 per acre in Oklahoma to an average of $27.32 in Washington.

IRRIGATION IN CANADA

Finally we come to the development of irrigation in Canada—one of the newest, though not actually the latest, nations to take up the problem. By "Canada" is especially meant Western Canada, because the study and application of irrigation has been confined almost entirely to the West. The two prairie provinces of Saskatchewan and Alberta, and the Pacific Coast province of British Columbia, have been the centres of development. In the prairie provinces irrigation has been considered from the standpoint of the grain-and-stock farmer—in British Columbia, more particularly from that of the fruit-grower.

In introducing to the reader's consideration the irrigation system now being developed by the Canadian Pacific Company in Alberta—the largest individual irrigation project on the American continent, with an area larger than the total irrigated area in either Colorado or California, nearly double that of Montana, nearly treble that of Wyoming, and greater than one-fifth the total irrigated areas of the United States—it should be emphasized, at the outset, that this undertaking, involving as it does an extremely heavy capital expenditure, has not

been necessitated by the same adverse climatic or soil conditions that have caused the creation of irrigated tracts elsewhere. Southern Alberta is neither arid nor desert.

The creation of the "Irrigation Block" is an essential part in the progressive colonization programme carried on by the railway company, in the expectation that the block would contribute a heavy traffic to the freight interest. The basic function of a railroad is, of course, the conveyance of passengers and freight; but conditions on this continent, especially in the West, are such that railway enterprise has not been able to confine itself to this one activity. Both in Canada and the United States, many of the railway companies have had to create the traffic they desired to carry. Broadly speaking, intensive methods of agriculture have not been practised. To promote them will be one of the missions of irrigation.

The presence of an irrigation project is accounted for by a desire on the part of the railway company to see the Irrigation Block the home of the most closely settled and prosperous mixed farming, stock raising and dairying community in Western Canada, and unless this result is actually achieved its aim will not have been fulfilled. Its aim never was to make any immediate profit out of the sale of irrigable lands or of the business of selling water; and, as a matter of fact, the annual rental for water does not cover the operation and maintenance expenditure.

THE CANADIAN PACIFIC RAILWAY'S IRRIGATION BLOCK

Irrigation in Southern Alberta may be said to date from 1892, when a series of dry years turned the attention of the settlers to the possibilities of aiding the growth of their crops by the artificial application of water. The question subsequently assumed such importance as to warrant its being taken up by the Government, with the result that well-considered and comprehensive laws relating to the use of water for irrigation were passed; a system of general surveys undertaken to determine the source and value of available supplies, and the location of the areas where such water could be used to the best advantage.

These surveys showed that three extensive areas offered special advantages for irrigation—one containing some 150,000 acres, situated in the Lethbridge district, which could be supplied from the St. Mary river; a second containing about 350,000 acres, lying near the junction of the Bow and Belly rivers, in townships 11 to 14 inclusive, ranges 11 to 16 inclusive; and a third, a much larger one, situated along the main line of the Canadian Pacific Railway and extending about 150 miles east of the City of Calgary. It is notable that the works to serve all of these tracts have either been built, or are now under construction.

An irrigated farm in Alberta.

The third-mentioned project eventually passed into the hands of the Canadian Pacific Railway Company, and is now known as the Bow Valley Irrigation Block. It was conceded that its development and colonization along proper lines would add materially to the selling prices of the land, would do away with the uncertainty of getting sufficient moisture for certain crops in certain years, would admit of intensive farming on smaller areas, and would result in settlers being attract-

ed in greater numbers than could otherwise be expected; all of which are the basis of the revenue-producing value of any agricultural country as far as traffic receipts are concerned.

The Bow River heads in the Bow Lakes on the eastern slope of the Rocky Mountains; and with its tributaries has a drainage area of about 3,800 square miles at Calgary, and about 5,100 square miles at Bassano. It generally reaches its highest stages between June 15th and August 15th of each year, and its lowest stages during January and February. Its maximum flood discharge at Calgary has probably been close to 100,000 second feet, although the hydrographic records for both extreme high and low water are rather meagre.

The Block is an open prairie plateau with a general elevation of about 3,500 feet above sea level at its westerly limits, sloping gradually until a general elevation of about 2,300 is reached at its easterly boundary. Its topography is rolling, particularly in the western sections, whereas large areas of almost level plains are found at its easterly limits. The soil is good, consisting of a heavy black loam and clay subsoil in the westerly portions, and a lighter sandy loam of great depth overlying clay and hard pan in its easterly limits.

It is bounded on the west by the Fifth Meridian, on the south by the Bow River, on the east by the line between ranges 10 and 11, west of the Fourth Meridian, and on the north by the Red Deer River and the north boundary of township 28. Its length east and west is about 140 miles, and it has an average width north and south of about 40 miles. It is intersected by the main line of the railway, and numerous other railway facilities have been or will be provided in various directions. It contains an area of 4,840 square miles, or 3,097,580 acres.

The precipitation varies considerably from year to year, and decreases easterly as the altitude becomes lower. The average annual rainfall at Calgary between 1886 (since when meteorological records exist) and 1913 was 15.58 inches. The average for the irrigation period of five months, from May 1st to October 1st, covering the same years, was about 11 inches.

Surveys in connection with the project were commenced by the railway company in 1903, and have gradually extended in detail since that date. This represented a vast amount of work, as an irrigation project demands surveys and examinations far more complete than those for a railway line. On the completion of the preliminary surveys it became evident that the Block naturally divided itself into three sections, which were designated as the Western, Eastern and Central, of about one million acres each; and the work has been carried on along the lines of development in the order stated. The Western and Eastern sections are complete units in themselves, whereas the Central Section, owing to its general elevation, could only be served by an enlargement of a portion of the trunk lines in the Western Section.

WESTERN SECTION

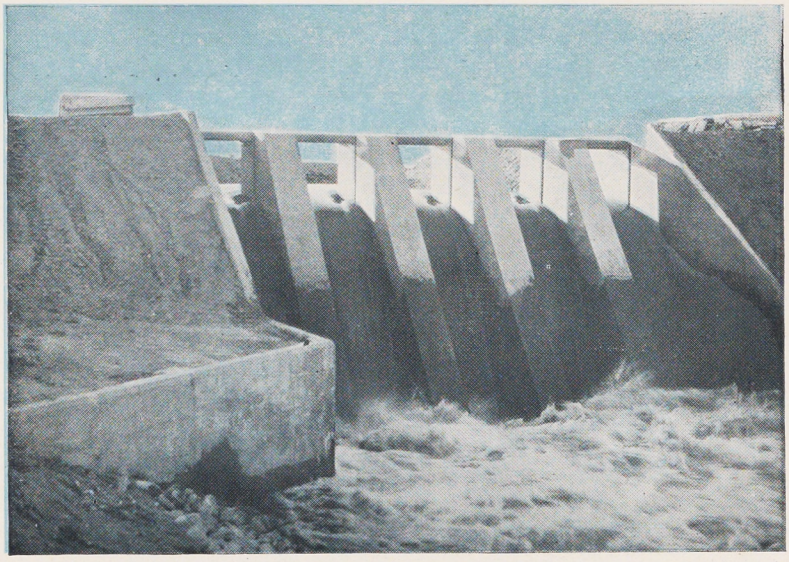
The Western Section is composed of 1,039,620 acres, of which about 370,000 acres have been brought under irrigation. The water for this section is diverted from the Bow River at a point just inside the easterly limits of the City of Calgary. From there, it is carried south and east through a main canal, 17 miles in length, which in part is 60 feet wide on the bottom, 120 feet wide at the water line, and designed to carry water to a depth of ten feet. The larger portion of this canal, however, is 44 feet bed width and 84 feet on the water line.

This main canal delivers water to a reservoir, for which a natural depression has been utilized, and where by the erection of a large earth dam a body of water three miles long, half a mile wide and 40 feet in depth has been created. Just before reaching this reservoir the main canal makes a vertical drop of 10 feet. From the reservoir, the water is taken out in three secondary canals, "A," "B" and "C," and carried to the different districts to be irrigated. These secondary canals have a combined length of about 250 miles, and are the following sizes at their westerly ends:—

Secondary Canal "A," 18 feet bed width, carrying 8 feet of water.

Secondary Canal "B," 28 feet bed width, carrying 6 feet of water.

Secondary Canal "C," 40 feet bed width, carrying 6 feet of water.



Drop, Secondary Canal "C," Western Section

From these secondary canals, the water is again taken out and distributed in each irrigation district through a comprehensive system of distributing ditches, which bring the water to each parcel of land irrigated. In the Western Section, the following mileage of waterways has been constructed:—

Main Canal	17 miles
Secondary Canals	254 miles
Distributing Ditches	1329 miles
	1600 miles

In addition to the above, there are several hundred miles of small ditches constructed by the farmers to distribute the water over their farms. The structures, consisting of headgates, spillways, drops, flumes, bridges, weirs, etc., are numbered in thousands, and in their construction ten million feet B.M. of timber and ten thousand cubic yards of reinforced concrete were used. In completing the canal system, ten million cubic yards of material were excavated. Of its total area, both irrigable and non-irrigable, less than five per cent remains unsold.

EASTERN SECTION

The Eastern Section is composed of 1,156,224 acres, of which approximately 440,000 are to be rendered irrigable. Most of this land is of a gently rolling character, and susceptible of good drainage. This system will be entirely independent of the other sections, having an independent intake, located about three miles south-west of Bassano, a town on the main line of the C.P.R., 83 miles east of Calgary.

The system takes advantage of a low pass through the rim of the Bow Valley at the point referred to, known locally as Horseshoe Bend, to take water from the river by an intake. For this purpose a huge dam has been constructed, and recently completed. Its functions were conceived as twofold; firstly, to raise the level of the water at the intake, thereby enabling the system to command a much larger area than it otherwise could do, and secondly, to reduce the quantity of material that had to be removed from the main canal cut heading from the dam.

Just above the site of the dam, the Bow River made a long bend in the shape of a horse-shoe. The banks on the outer side were high and massive; but inside, the land, before its submersion, sloped gradually down until the banks on the inner side of the then existing channel were scarcely any higher than the level of the stream. Merely to have dammed the river would not have been sufficient, and would have resulted only in its diversion into a new channel, across the low-lying tongue of land comprised within the horse-shoe. The whole of this tongue had to be submerged and a great pool formed.

The dam, therefore, is a composite structure, consisting of a reinforced concrete spillway in the original river channel that continues in a long, high earthen embankment across the foot of the horse-shoe shaped tongue. The spillway is of the Ambursen type, and consists of a heavy floor built upon the bed of the stream, with suitable cut-off walls at its upstream and downstream edges; and upon this floor are erected parallel buttresses of substantially triangular outline, with a slope to the upstream edge of about 45 degrees. Upon brackets projecting from the faces of the buttresses are cast concrete slabs to form a deck, terminating at the top of the buttresses in a curved crest and passing down over the downstream side in the form of an apron curved to correspond as nearly as possible to the path of the over-fall flood waters. The structure is 720 feet in length between abutments, with a maximum height of 40 feet to the overflow crest, above which eleven feet of water are retained by twenty-four sluice gates, operated by electricity. Rising from each alternate buttress and separating the gates are piers carrying a road bridge.

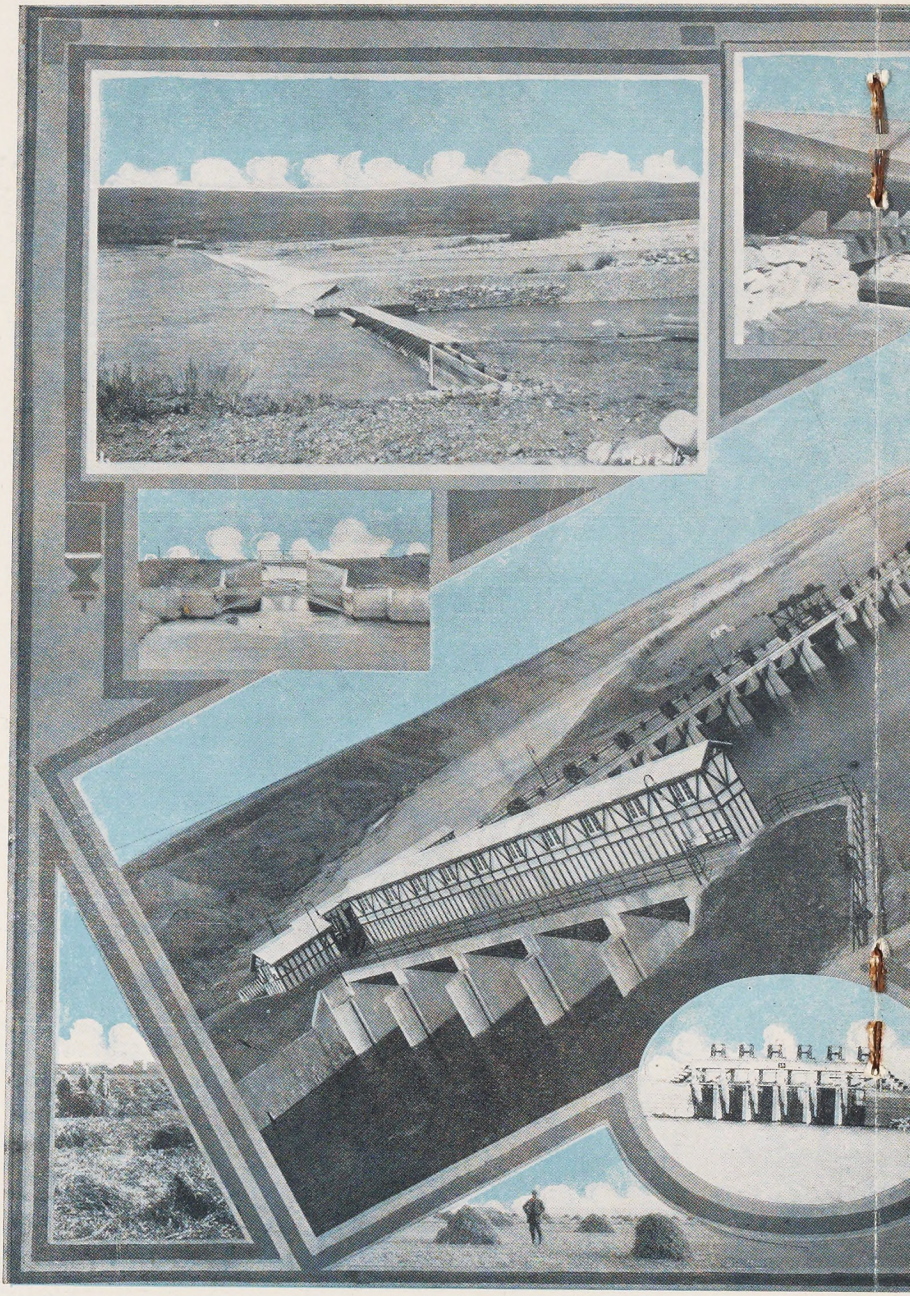
The earthen embankment is some 7,000 feet in length, and extends from the south end of the spillway until it meets and merges with the sloping ground running down to the river. At its highest point it is 350 feet in width at the base; and it contains about one million cubic yards of earth. The spillway contains some 40,000 cubic yards of concrete and 2½ million pounds of reinforcing steel. Construction on both parts was begun in the summer of 1910.

At the north side of the spillway, and at right angles to and just inside it, are located the headgates of the main canal by which the system is served. The elevation of the sills of these headgates is 35 feet above the original low-water level of the Bow River, and above the sills are the eleven feet of water retained by the gates of the spillway, making a total height of 46 feet that the level of the water has been raised. The headgates consist of five openings each of twenty feet, with electrically operated sluice gates, and control a discharge into the main canal of 3,800 cubic feet per second.

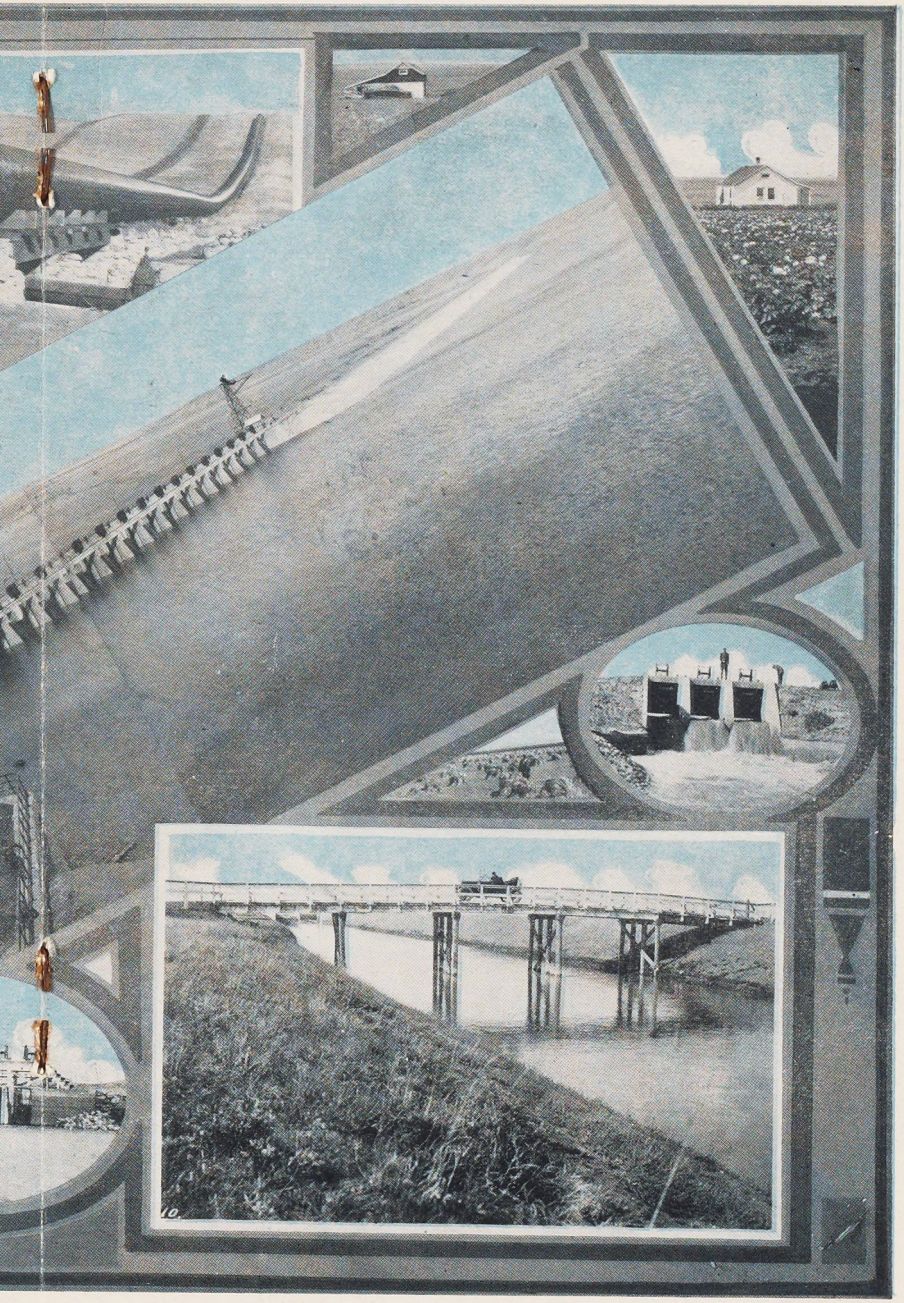
From the headgates, the main canal leads to a point about five miles distant, where an earth dam 1,280 feet long and 35 feet high. is built across the valley to form a tail pool from which the branch canals are fed. There are two of these—the North Branch and the East Branch. The North Branch is the smaller, and serves the country lying north and west of Mat-zi-win Creek, the valley just mentioned. At the outset, this canal is about 30 feet bed width, carrying about 6½ feet of water. After crossing the railway line, it follows the west flank of a deep valley known as the Crawling Valley to a point about eight miles north of the intake, where it crosses the valley by a flume 1,390 feet in length, and then runs northerly. It has numerous branches, and becomes smaller as the distributaries are thrown off, finally tailing off into the Red Deer River.

The East Branch, heading from the tail pool of the main canal, has a size at the outlet of 70 feet bed width, carrying 9.3 feet of water. Its general course is south-east, and it serves the balance of the country not supplied by the North Branch. Near Lathom, the first branch takes off, crossing the railway and watering a large area between the two forks of the Mat-zi-win Creek. This branch is known as the Spring Hill canal and is 35 feet bed width, carrying seven feet of water.

The East Branch continues south-easterly, reaching the height of land at the head of Antelope Creek. At this point, it again forks, the south-easterly branch being known as the Bow Slope Canal, which is about 17 feet bed width, carrying 5 feet of water, and will serve all the land on the Bow River slope. At Cassils two smaller canals are taken off, and just south of Brooks the East Branch discharges part of its water into Lake Newell reservoir, which is being formed in a depression in the Little Rolling Hills by the construction of a number of earth dams, the largest of which will be about 2,000 feet long and 30 feet in height. The storage capacity of this reservoir will be about 185,000 acre feet. The balance of the water in the East Branch will go down

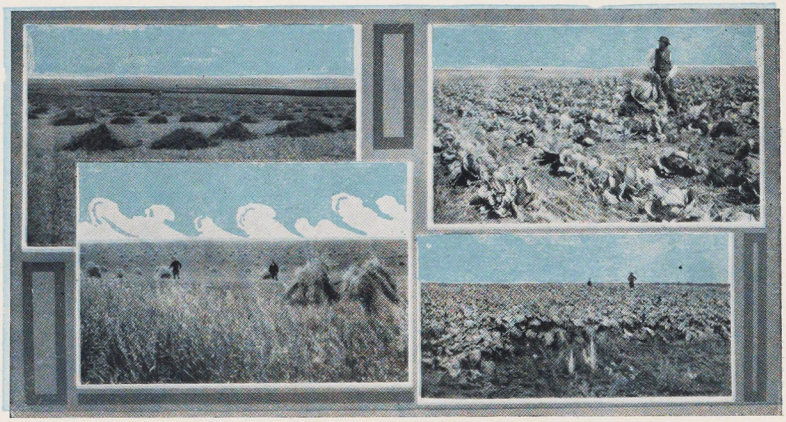


Centre—General View of the Bassano Dam (Eastern Sec
Bottom Right, Main Canal A, Western Section. The



stern Section); Top Left, Intake and Diversion Dam, Lethbridge Section;
n. The otherviews show structures and scenes in the Irrigation Block.

the east flank of the Rolling Hills on a high grade line in a canal known as the Rolling Hills Canal, the size of which is about 20 feet bed width, carrying 5½ feet of water.



Alfalfa, Oats and Garden Truck

The outlet from the reservoir will be a canal about five miles in length and about 40 feet bed width, carrying seven feet of water. At its easterly end it will discharge into a large reinforced concrete flume, about 10,000 feet in length, which will carry about 900 cubic feet of water per second over a deep notch in the watershed and deliver it to the Bantry Canal, which will serve north and south of the Bantry Hills. The Bantry Canal, until it forks, is about 45 feet bed width, carrying 7½ feet of water. After it forks the east branch is about 20 feet bed width, carrying 5½ feet of water.

The estimated mileage of canals and ditches to serve this portion of the Block are:—

Main Canal	5 miles
Secondary Canal	475 miles
Distributing Ditches	2,020 miles
	2,500 miles

The earth which it has been necessary to remove in connection with these ditches and canals will amount, when the section is completed, to over twenty million cubic yards.

The Eastern Section has been designed with a view to the adoption of rotation in supply, resulting in each individual water-user obtaining a satisfactory head and a fair division of water, and the simplification of operating problems. This is a matter which cannot be worked out in detail until the lands are more closely settled, but the system is being planned on the basis of giving parcels of between 80 and 160 acres a supply of two second feet for a period of 96 hours, and parcels smaller than 80 feet a similar flow for 48 hours. A large portion of the irrigable lands are now open for settlement, a start being made with the location, in the early spring, of a score of families who came up from Colorado and took up "ready made farms" north of Bassano.

CENTRAL SECTION

The Central Section contains 901,740 acres, and it was at first intended to irrigate about one quarter of this area. Up to date construction of this portion of the system has been held in abeyance.

LETHBRIDGE SECTION

In the spring of 1912, the Canadian Pacific Railway acquired the irrigation system referred to previously as the first of the three possible irrigable areas in Alberta (then owned by the Alberta Railway and Irrigation Company), and is now administering it under the name of the Lethbridge Section. This, the pioneer irrigation enterprise on a large scale in Western Canada, was started in the year 1898, and was constructed at an expenditure of over one million dollars. The headgates and diversion works are situated on the St. Mary River, near the north-east corner of Township 1, Range 25, west of the Fourth Meridian, and about 50 miles south-west of Lethbridge. The St. Mary River, like the Bow River, is a mountain river fed by the melted snows and glaciers

of the Rockies, and does not depend upon natural precipitation for its volume. The main canal of the system has now been enlarged to carry 800 cubic feet of water per second, the mileage of canals and ditches operated by the company being 230. The area under irrigation is 120,000 acres, and are mostly tributary to the railway lines between Lethbridge and Magrath, and Lethbridge and Chin.

The successful outcome of any large irrigation project is only partially solved by good construction, and in some cases the administrative heads of large schemes have failed to realize that the ultimate success of such enterprises cannot be fully brought about without the farmers, and that it is the labors of the latter which determine the real value of such properties. With this realization, the sale of the lands in this Block warranted the establishment of a large organization which has extended over all important points in Canada, the United States, Great Britain and parts of Continental Europe.

THE AIM OF IRRIGATION

The history of irrigation enterprises in the United States has demonstrated that the basis of irrigation is not so much the production of either fruits, cereals, garden truck or other expensive crops as the feeding and finishing of live-stock and the development of dairying in its various branches. That animal husbandry vastly overshadows any other line of agricultural endeavor on the irrigated farm was so apparent that the Canadian Pacific Railway has from the first focussed its attention on its progress. The raising of fodder crops is therefore of paramount importance; and, it may be said at once, in few cases can it be carried on so successfully as in Southern Alberta.

Alfalfa has long since passed the experimental stage in the province of Alberta, and has proved one of the surest and most profitable crops. Alfalfa, says George L. Clothier, late of the U.S. Department of Agriculture, is one of nature's choicest gifts to man, the preserver and conserver of the homestead. "Alfalfa makes the hen cackle and the turkeys gobble. It induces the pigs to squeal and grunt

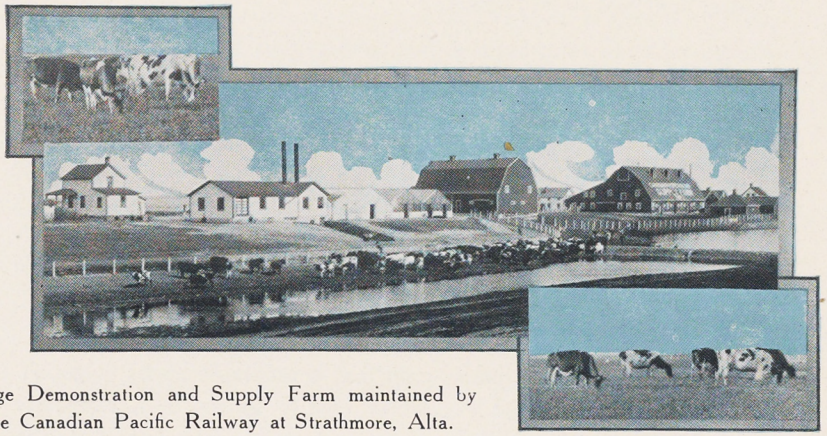
with satisfaction. It causes the contented cow to give pails full of creamy milk, and the steer to bawl for the feed rack. It softens the disposition of the colt, and hardens his bones and muscles. It fattens lambs as no other feed, and promotes a wool clip that is as a veritable golden fleece. It compels skim milk calves to make gains of two pounds a day. It helps the farmer to produce pork at a cent and a half a pound and beef at two cents."

Encouragement for the live-stock industry is found in the large and constantly expanding market for all kinds of food products, consequent upon the great increase in population during the past decade through immigration—a market that as regards prices is stable and satisfactory. The fact that so large a proportion of the food products consumed in Western Canada were until recently imported afforded a very cogent reason why an attempt should be made to supply the demand by home production; and now that, according to indications, the tide seems turning is a matter for some congratulation.

Timothy is another fodder crop that is profitable under irrigation. All varieties of roots and vegetables usually grown in a temperate climate can be raised, and there is just as large a demand, and for the same reason, for all kinds of garden produce. Small fruits of the berry types can be grown very successfully. The raising of sugar beets is another department from which great activity may be expected.

The irrigation of grain crops is to be considered as a method of insurance. While it has already been pointed out that irrigation is not necessitated in southern Alberta by the same rigorous conditions that have rendered imperative the creation of irrigated tracts elsewhere, that statement must be qualified by the admission that there are occasional seasons in which the district receives a rainfall insufficient in its total volume, or so irregular in its distribution as to preclude the possibility of first-class crops. Such a year has been the present one, which has forcibly demonstrated the value of this aspect of irrigation. At all times, too, irrigation increases the yields from the land. Experiments

conducted at the Dominion Government Experimental Farm at Lethbridge have shown that the six-year average of Marquis wheat on irrigated land is 44.37 bushels to the acre, compared with 25.02 bushels on non-irrigated land; of Banner oats, 96.23 bushels, as against 61.26 bushels; and of 2-rowed barley, 70.35 bushels as against 40.22 bushels.



Large Demonstration and Supply Farm maintained by the Canadian Pacific Railway at Strathmore, Alta.

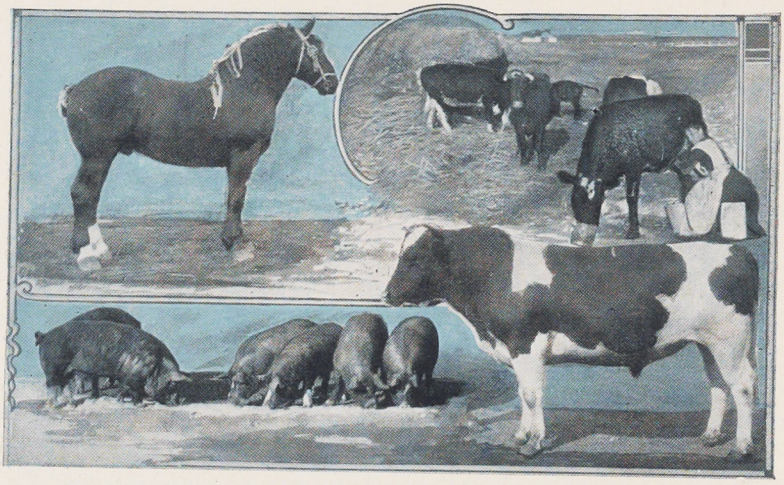
COLONIZATION METHODS

At the beginning of 1913, a radical change was made in the methods by which the Canadian Pacific Railway had hitherto been selling its land holdings in Western Canada, which included the Irrigation Block in Southern Alberta. This change had a very direct bearing on the aggressive colonization policy which the company desired to press forward. All unsold land was withdrawn entirely from sale for speculative purposes, and dealings have since been conducted only with those who give assurance of their intention of residing upon and developing the land they purchase. The settlers who flock to Western Canada come from the United States, other parts of Canada, the British Isles and Northern Europe, and it was to attract the best of these that the following proposition was framed.

Firstly, the period over which the payment of land was spread has been extended from ten to twenty years. Secondly, to approved applicants there is available a loan to the value of $2,000 for the purpose of permanent farm improvements, repayable, also, in twenty years. To settlers who have the requisite knowledge and accommodation, an advance of live-stock to the value of $1,000 is made on easy terms of credit.

Where the loan of $2,000 is used, the following conditions are required to be observed. The purchaser (who must be a married man with agricultural experience) must have sufficient capital to enable him to pay the first instalment on the land and one-twentieth of the amount of the loan desired, together with the amount necessary to maintain his family for a year; as well as owning, free from encumbrance, or having the means to purchase, sufficient horses and implements to enable him to go into occupation and proceed with the development of his land.

After the acceptance of his application, the company will expend a sum not exceeding $2,000 for improvements, namely, and in the order stated, the erection of a house and barn (both of which are to be selected from the company's standard plans), fencing, and the provision of a well and pump. The cost of these improvements will be paid by the Company and charged against the advance; and the purchaser, with any stock or equipment he has, will, at the company's discretion, be employed in connection therewith at current rates of labor. The total amount of the advance will be added to the price of the land and the repayment of the whole spread over twenty equal annual instalments with interest at the rate of 6% per annum. The purchaser must enter into occupation within six months from the completion of the improvements and must undertake to reside thereon continuously for five years, and to break, cultivate and crop certain stated areas in each quarter section and to maintain during the required period of occupancy at least three milch cows for each quarter section. The maximum amount of land sold to one man under this policy is 320 acres.



Here, as elsewhere, the breeding of live-stock is the basis of every prosperous Irrigation community.

Where a purchaser prefers not to avail himself of the loan, he is required to enter into occupation within six months from the date of purchase, to occupy his lands the six summer months in the five years following the purchase, to undertake to build a house costing at least $350 and a barn costing at least $200, capable of accommodating four horses and four cows, to keep the buildings insured against loss from fire, to sink a well, fence the land, and break and crop a stated area in each quarter section, or in lieu maintain a stated number of live stock which are his own unencumbered property. The maximum amount of land sold under this policy to one man is 1,280 acres.

The Company, some three or four years ago, inaugurated its now well-known "Ready Made Farm" scheme. This was primarily designed for the benefit of the British yeoman farmer who, although desirous of emigrating to Western Canada, was not disposed to undertake the pioneer work necessarily entailed in building a new home on the prairies; but the scheme has since been extended to allow of the par-

ticipation of farmers from the United States or Canada. The advantages of a "ready made farm" are that it provides a settler with a home for himself and family immediately upon arrival, and that the farm is almost immediately revenue-producing. The size of the farms varies, but the majority of them are 160 acres. The improvements are the same as in the case of the "loan farm," with the addition of the breaking and cultivation of a certain area, varying from 50 to 100 acres, which is, if desired, seeded as well. The farms are sold at the price of raw land, plus the cost of improvements. The Company has now 21 "colonies" of these farms, comprising over 400 farms either developed or being developed, and the majority of these are within the Irrigation Block.

Irrigable land is sold on any of the three methods outlined above, but in no case is more than 320 acres sold to one man.

WELFARE WORK AMONGST FARMERS

Colonization is not merely the sale of land. Any agency that ceases its efforts with locating the settler in his new home has not fulfilled its mission. There may be new conditions with which the newcomer is unacquainted. It is highly desirable that the new farm shall make some return as quickly as possible, to balance the investment put into it; and when difficult problems arise, as they are almost bound to do under novel surroundings, it is equally desirable that advice should be available and assistance within reach. The success of any colonization agency is directly co-related with the success of every individual settler, and therefore the highest endeavor is that which watches the settler's progress from year to year and is as eager to help him after he has located, as it was to secure him before.

The Canadian Pacific Railway has adopted such a policy. In its campaign for the advancement of agriculture, it takes it as a fundamental principle that only a diversified system of farming will bring the Canadian prairies to their highest and most economical production. Every effort is accordingly made to turn the Western farmer from one-crop systems to methods involving the raising on every farm of fodders,

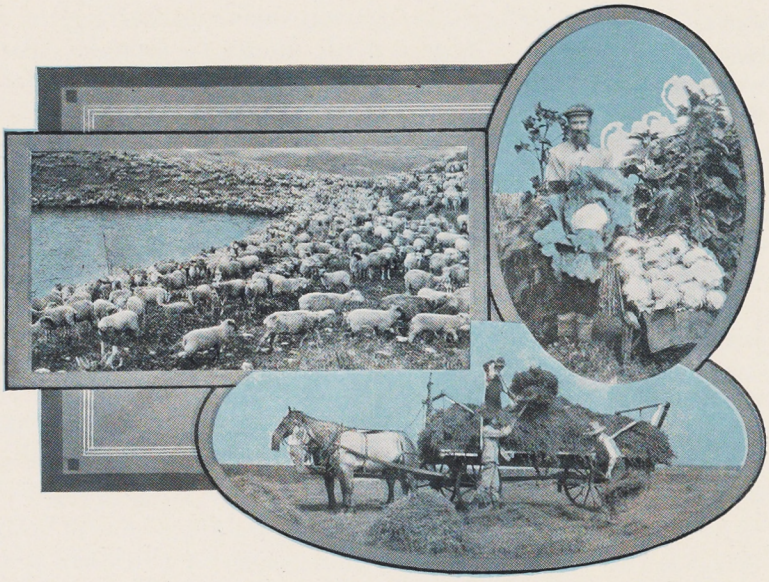
grains, vegetables, roots and live-stock. It has already been stated that to approved settlers live-stock to the value of $1,000 is advanced on easy terms of credit. In addition to this, the company has established throughout the West twelve "mixed farms," of generally one-quarter section each, the purpose of which is to serve as strategic centres in the campaign for mixed farming and to show just what operations can be profitably carried on on the small farm. Five of these farms are situated in the Province of Alberta. At Strathmore, a large demonstration farm of 3,100 acres is operated, at which cream, poultry and eggs are purchased from farmers in the surrounding districts and sold to the dining-car and hotel departments of the railway.

From time to time various competitions have been started, including two for the raising of alfalfa, one for tree-planting, and others for live-stock raising, of which latter the most interesting was a steer-feeding competition for farmers' boys. Pure-bred bulls for service are placed at various points, at an insignificant charge. Alfalfa and timothy seed have been supplied on credit in the Irrigation Block. In conjunction with the provincial departments of agriculture, the company has run agricultural demonstration trains on its system in the west, these trains carrying exhibits of pure-bred stock and grains and manned by agricultural experts and lecturers.

WHERE IRRIGATION LAWS ARE JUSTER

It is of the greatest importance that the laws under which irrigation is practised should be so framed as to avoid discord or dispute. In some States, as much money has been swallowed up in litigation as upon actual development.

Some of the leading experts of the continent have said that the Canadian laws and their administration approach as nearly perfection as possible. The United States Department of Agriculture, in Bulletin 96, recommends the Canadian laws to the consideration of those whose duty it is to prepare irrigation laws for use in those States where irrigation is practised or likely to be practised.



Some Products of Irrigation in Alberta

One of the essential differences is that while south of the line each state makes its own irrigation laws, in Canada there is only one law, a federal law. The fact that irrigation is practised in Canada only in the West does not weaken the strength of this distinction, for it makes any action that might arise correspondingly important. The oversight of all irrigation enterprises is in the care of a special Irrigation Department acting under the Department of the Interior, and its supreme head, the Minister of the Interior, holds a portfolio as a member of the cabinet of Canada.

The ownership of water is distinct from the ownership of land, and as the granting of land can only be done by a patent from the Crown (that is, the Government of the Dominion of Canada), so, similarly, the property in and the right to the use of any inland body of water of any kind is vested in the Crown alone, and the utilization of

water for irrigation or any other purposes can be granted only by a licence from the Crown. In other words, the title for the water rights, while separate from the title for the land, is equal to and as good as the latter.

Every promoter of an irrigation enterprise must apply to the Minister of the Interior for a licence to perform the preliminary work in the location of the proposed works, and must file a plan showing especially the source of supply, the position of the intake, and the location of the main canals and ditches. These plans and all details are on file for public inspection for thirty days, after which, if there has been no protest made against the granting of the water-rights desired, the construction of the system is authorized, with, if necessary, any changes that are indicated by the engineering advisers of the Department. When the works are completed, and after an examination by the chief engineer of the Department, a licence is issued to the applicant for the quantity of water to which he is entitled. These licences rank in priority of application, and no one can obtain any undue supply of water until those who precede him are satisfied.

It is further laid down that where any works constructed are not of sufficient capacity to carry the full volume of water to which rights have been acquired, the right shall be limited to the actual capacity only. It is also enacted that no licensee shall, after the expiration of four years' time from the construction of the works, discriminate in prices charged to water-users, and that where the amount of water agreed to be supplied by a licensee to a water-user is not available, then each water-user must be supplied in the same proportion that his usual supply bears to the whole volume. The amalgamation of irrigation companies is subject in every case to the preservation of the rights of every individual dependent upon the water supply. Complaints of bad service are made to the Minister of the Interior, who may order an inspection and where necessary remedy any defect. The Minister has powers to expropriate any irrigation works at any time if it is within the public interest.

Amongst the powers conferred on the Minister of the Interior are:—to define the manner in which the measure of water shall be arrived at, to define the duty of water according to locality and soil, to define the portion of the year during which water shall be used for irrigation, to regulate the extent of diversion from rivers, streams, lakes or other waters, to regulate the water rates which may be charged by licensees to water-users and the manner in which water is to be supplied to persons entitled to it, whether continuously or at intervals, to make observations on the volume of water in all waterways, and to take any necessary steps to protect the sources of water supply and to prevent any act likely to diminish or injure the supply.

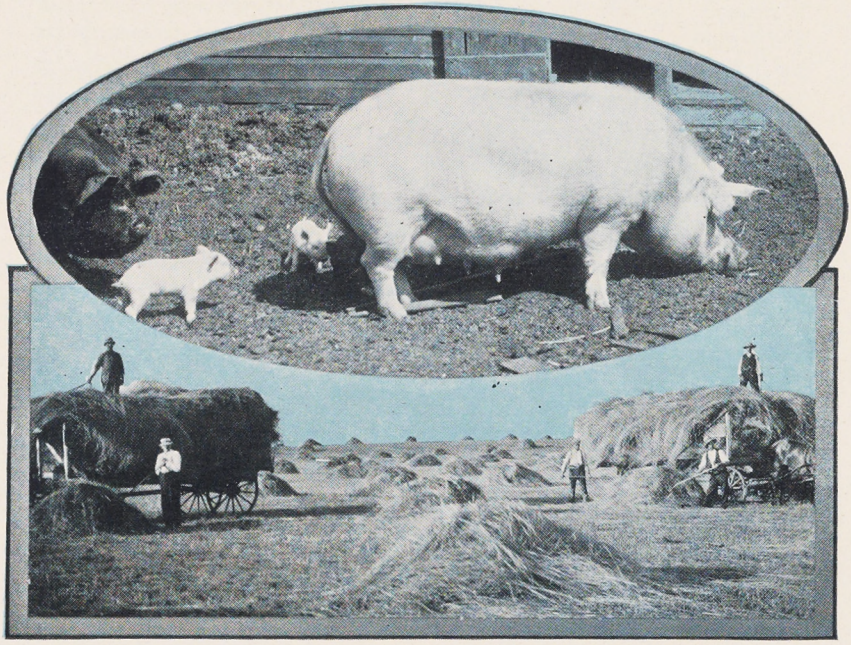
These regulations are not, of course, designed to impede irrigation development, but to ensure that the water-user is given a square deal. In the case of the Canadian Pacific Railway Company's irrigated lands, the water-user enters into an interim water-agreement fixing the rental he is to pay for water, and when he has paid in full for his land and has secured the title thereto, the interim agreement is superseded by a final water-agreement of a similar tenor. The Canadian Pacific Railway Company, recognizing that in a few fields of agricultural endeavor is the principle of co-operation so successful as in irrigation, affords every facility for the formation of Water-Users' Associations, comprising consumers located on any distributary ditch system, leaving such bodies to arrange the proper rotation and finally to transfer the delivery of water and the supervision of the maintenance of the distributary ditches to elected representatives.

THE WESTERN CANADA IRRIGATION ASSOCIATION

Seven years ago, the growing importance of irrigation in this country led to the formation of the Western Canada Irrigation Association—the first, and until now the only, organization of its kind in Western Canada. The original "Official Call" said:—

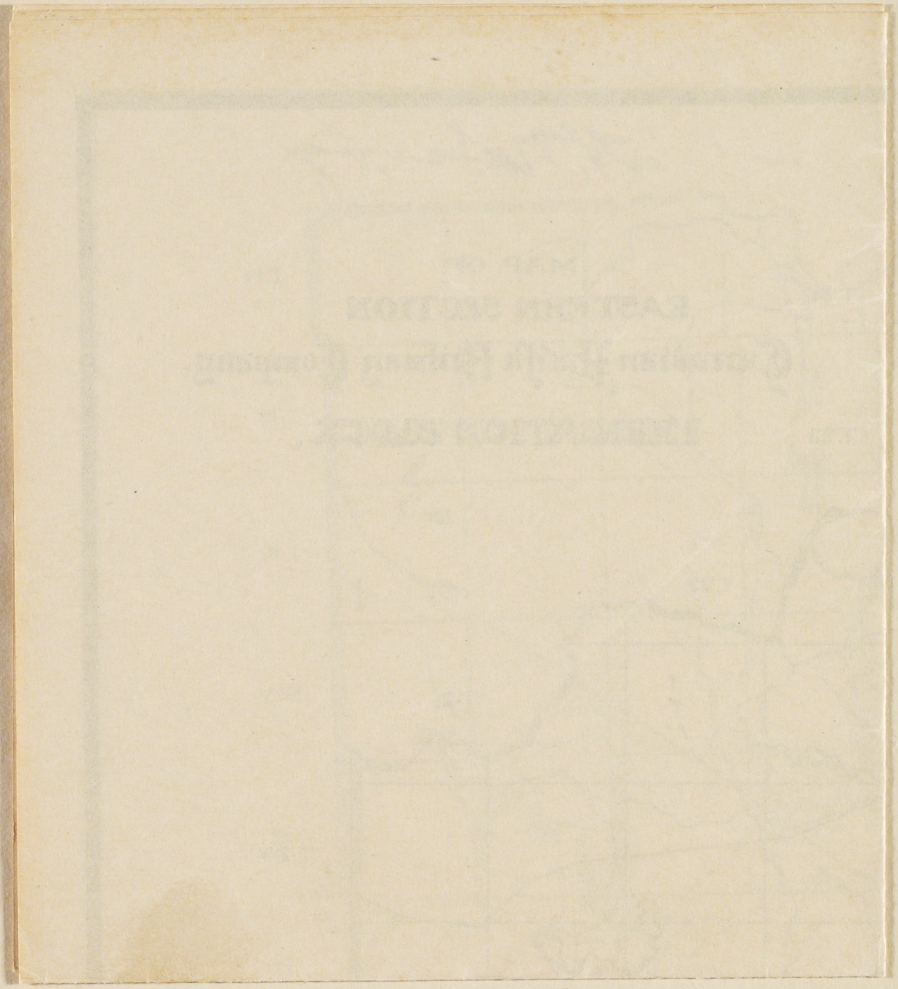
> "It is gradually dawning in the minds of thinking people that the most significant development in agriculture that Western Canada has yet witnessed is the movement to utilize the great mountain

streams in aiding the farmer largely to eliminate the element of uncertainty from his operations. . . . The development is yet in its infancy. Our mountain ranges contain natural reservoirs only awaiting the finishing touches of skill and labor to save water sufficient to irrigate vast areas, in addition to those that are now or can be provided for by our normal water supply. A propaganda so vast and fraught with such far-reaching interests, that enter so closely into the whole problem of Western Canada's colonization and future prosperity, is of deep concern to every resident of the great West, and imperatively demands the impetus, constructive guidance and moulding influence that can only be brought to bear most effectively through a strong permanent organization."



Top—The Great Alberta Hog; Bottom, Harvesting Timothy.

The first convention was held in Calgary in July 1907, and was attended by over one hundred enthusiastic delegates; the eighth convention, held at Penticton, B.C., in August of this year, was attended by many times that number. With membership increased until it now includes almost everyone prominent in the colonization and agricultural improvements of the west, the association has grown equally in prestige. Supported by grants from the provincial governments of Alberta and British Columbia, and from the federal government of Canada, it is actively engaged in forwarding the interests of all irrigation farmers; and the success which has attended its operations have been marked. The basis of representation at the conventions, as established by the constitution, is wide, providing for the presence of all connected in any way with the theory or practice of irrigation, whether from the engineering or colonization aspects, of delegates from the forestry, hydrographic, experimental farm and conservation services of Canada, civil engineers, land surveyors, railway companies, newspapers, agricultural, forestry, horticultural, live-stock and affiliated associations, municipal, village and rural organizations, and all Boards of Trade, Chambers of Commerce and kindred bodies in the three provinces mentioned above.



H. M. Savage

MAP OF EASTERN SECTION Canadian Pacific Railway Company. IRRIGATION BLOCK.